Infectivity of *Entomophthora delphacis*
(Entomophthorales: Entomophthoraceae)
to the Cotton Aphid, *Aphis gossypii*
(Hemiptera: Aphididae)¹

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In a previous paper (SHIMAZU, 1976), the author reported the morphological and cultural characters of *Entomophthora delphacis* HORI, and suggested that it bore close morphological similarity to *Entomophthora aphidis* HOFFMANN and *Entomophthora dipterigena* (THAXTER). To clarify the relationships between *E. delphacis* and other similar entomophthoraceous fungal species, a survey of the host range of *E. delphacis* is required. Therefore an inoculation test of this fungus on the cotton aphid, *Aphis gossypii* GLOVER, was carried out, and the results compared with those of *E. aphidis*. The relationship between the host ranges of *E. delphacis* and *E. dipterigena* was not investigated in this experiment.

E. delphacis isolated from the brown planthopper, *Nilaparvata lugens* (STÄL), in the field was subcultured on SABOURAUD's dextrose agar containing 1% yeast extract. During the subculturing, the fungus was passed through the brown planthopper to prevent reduction of its virulence. *E. aphidis* was isolated from the grain aphid, *Rhopalosiphum padi* LINNÉ, in the field and subcultured on the medium. Each fungus was cultured on the above-mentioned medium in a petri dish of 9-cm diameter to obtain the inoculum. A piece of a leaf of taro, *Colocasia esculenta*, was floated on water in a petri dish of the same size. Cotton aphids collected from a taro field were placed on the floating leaf, and the petri dish in which the fungus was grown as inoculum was inverted over the aphids. After one day, the aphids were transferred to other petri dishes (10 aphids/dish), each containing a piece of taro leaf floating on the water. Each fungus inoculated 50 or 100 aphids, and non-inoculated aphids were kept to check for natural contamination with entomophthoraceous fungi. The aphids were kept for 7 days at 25°C. The number of aphids killed by each fungus was counted

Fig. 1. Daily mortality of *Aphis gossypii* killed by *Entomophthora aphidis* and *Entomophthora delphacis*.

daily. The experiments were repeated three times with *E. delphacis* and twice with *E. aphidis*.

Both fungi killed the aphids within 2 to 7 days after inoculation (Fig. 1). The highest percentage mortality was obtained on the fourth day after inoculation. These incubation periods were shorter than those of the brown planthopper and the green rice leafhopper, *Nephotettix cincticeps* UHLER, which were about 6 days (ranging from 3 to 13 days) (SHIMAZU, unpublished). The mortalities due to *E. delphacis* were 36.0, 50.0, and 38.0% in each experiment and the average percentage of infection was 41.0%; those due to *E. aphidis* were 28.0 and 54.0% in each experiment and the average was 41.4%. There was no significant difference between *E. delphacis* and *E. aphidis* in incubation period or mortality. This result shows that *E. delphacis* is pathogenic to the aphids. The aphids killed by *E. delphacis* turned to light brown or orange, and were covered by light-brown conidiophores, which were darker than those grown on the brown planthopper and resembled those grown on the culture medium. The wings of alate aphids were not covered by the conidiophores. This change of body color must be common to most aphids killed by *Entomophthora* (THAXTER, 1888). Most of the aphids killed by *E. delphacis* developed the conidiophores abundantly on their body surfaces; however, some of them developed few conidiophores and showed a powdery appearance, like the aphids killed by *E. aphidis* (Fig. 2). Both *E.*

¹ Appl. Ent. Zool. 12 (2): 200–201 (1977).

Fig. 2. *Aphis gossypii* infected with *Entomophthora aphidis* (A) and *Entomophthora delphacis* (B).

delphacis and *E. aphidis* on the dead aphids had branched conidiophores, long cystidia and elliptical conidia. The average size of conidia of *E. delphacis* collected from aphids was $26.6 (\pm 1.8) \times 15.5 (\pm 1.0) \mu$ and that of *E. aphidis* was $26.9 (\pm 2.1) \times 16.3 (\pm 1.6) \mu$, whereas that of *E. delphacis* collected from the inoculated brown planthopper was $26.4 (\pm 1.8) \times 16.8 (\pm 1.5) \mu$. No natural contamination by *E. delphacis* or *E. aphidis* occurred on non-inoculated aphids, but a few aphids were killed by *Entomophthora fresenii* (NOWAK.), which was clearly distinguishable by its peculiar conidia. *E. delphacis* was re-isolated from the inoculated aphid, and showed the same appearance as the original culture.

E. delphacis was first described by HORI (1905) as a pathogen of the brown planthopper and the white-backed planthopper, *Sogatella furcifera* HORVÁTH. As there were no references to related species such as *E. aphidis* or *E. dipterigena*, however, *E. delphacis* could only be distinguished from these species by their host ranges. Recently, the author isolated from the brown planthopper an entomophthoraceous fungus which resembled *E. aphidis* or *E. dipterigena* morphologically but differed in its characters on the culture media and the host, and was thereby identified as *E. delphacis* (SHIMAZU, 1976).

Up to this time three species of insect have been known as host of *E. delphacis*; namely, the brown

planthopper, the white-backed planthopper (HORI, 1905), and the green rice leafhopper (ESAKI and HASHIMOTO, 1936; ESAKI et al., 1937). In this experiment, it was proved that *E. delphacis* was pathogenic not only to the plant- and leafhoppers but also to the aphids. This is a new finding on the host range of this fungus and, at the same time, it means that *E. delphacis* not only resembles *E. aphidis* morphologically but also has the same host. According to GUSTAFSSON (1965), *E. aphidis* has been found only on aphids, and he believed it to be pathogenic to aphids only. When the author inoculated 54 brown planthoppers with *E. aphidis*, none was killed by the fungus (unpublished).

Accordingly, the entomophthoraceous fungus which resembles *E. delphacis* or *E. aphidis* and is found on the planthoppers may be recognized as *E. delphacis*, but such fungi found on aphids should not necessarily be judged as *E. aphidis* alone. This fact suggests that previous reported findings of *E. aphidis* on aphids could have included some *E. delphacis*. However, the occurrences of *E. delphacis* on aphids have not been confirmed in the field so far.

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